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EFFECT OF VARIETY AND PROCESSING PARAMETERS ON OIL CONTENT AND OIL PROPERTIES OF CASTOR SEEDS

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ABSTRACT

This paper carried out experimental studies on determination of oil content of four varieties of castor seeds available in North Eastern Nigeria, namely: White Big Size (WBS), Black Big Size (BBS), Grey Medium Size (GMS) and Grey Small Size (GSS). Methanol was used as solvent for the extraction process. Mass of oil extracted from the four varieties revealed that the GMS gave the highest oil content of 54.5% followed by the GSS of 40.17%. The WBS gave oil content of 35.5% and the least of 29.67% was observed from the BBS. The results of the statistical analysis shows that the observed differences between means of the oil content from these four castor seeds are significant at 5% level. The characterization analysis showed that the tested parameters, which include specific gravity, refractive index, acid value, iodine value, saponification value, viscosity were within the ASTM standard specifications.

KEYWORDS: Castor seed, soxhlet extractor, methanol, extraction, characterization, model equation

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INTRODUCTION

Castor plant, (*Ricinus communist L.)* is a member of the Euphorbiaceae, which contains a vast number of plants mostly native to the tropics (Akpan, *et al. 2006*). In Nigeria, castor is obtained in every part of the country. Its seed contains 40 to 60 % oil (Olaoye, 2000). The seed is referred to differently depending on the locality where it is found. The Yorubas call it 'Lara', the Hausas refer to it as 'Zurma', and the Kanuris call it 'Kwolakwola', while the Igbos refers to it as Ogilisi (Oluwole, 2010). The oil extracted from the seed is traditionally used as medicinal ointment, illuminant, and as raw material in the soap making industry. At present, the potential of castor oil is not fully explored in Nigeria. Figure 1 shows the pods of four common varieties of the crop that have been identified. These have been named as White Big Size (WBS), Black Big Size

(BBS), Grey Medium Size (GMS) and Grey Small Size (GSS) (Oluwole, 2010). Castor seed oil is a colorless to very pale yellow liquid with mild or no odor or taste (Akpan, *et al. 2006*). The oil is essentially a pure triglyceride and contains almost 90% of glyceryltrianoleate (Marter, 1981). Castor oil is an amber viscous liquid and is sometimes known as ricinus oil (Marter, 1981). The oil itself contains a number of fatty acids such as oleic acid, liniteic acid, stearic acid and palmitic acid. Among the vegetable oil however, castor oil is distinguished by its high content of ricinoleic acid that any other vegetable oil (Chakrabarti and Rafiq 2008). Castor oil is unique as it is the only source of an 18- carbon hydroxylated acid with one double bond (Chakrabarti and Rafiq 2008). The product uniformity and consistency of castor oil are significantly high for a naturally occurring material. It has unsaturated bond, high molecular weight, low melting point and very low solidification point which make it industrially useful. Castor oil have applications in the manufacturing of soaps, lubricants, hydraulic and brake fluids, paints, dyes, coating, inks, cold resistant, plastics, varnishes, lacquers, oil clothes, linoleum grease, waxes and polishes, nylon, pharmaceuticals and perfumes and also as a raw material in the manufacturing of various chemicals (Oluwole, 2010). At present, the processing of castor to extract its oil is not in commercial scale in Nigeria. This study aims at the extraction of castor oil from four varieties of the seeds commonly found in Borno State, Nigeria to determine their oil contents and properties.

MATERIALS AND METHODS

Materials and Preparation

Bulk quantities of four different varieties of castor pods used in this study were obtained from farmers in Kawuri village of Konduga Local Government Area, Borno State, Nigeria.

The pods were prepared by cleaning (removing dirt and stones by hand picking), and stored in polyethylene bags according to varieties namely: A-White Big Sized (WBS); B- Black Big Sized (BBS); C- Grey Medium Sized (GMS); and D- Grey Small Sized (GSS). Each variety was kept under shade for 2 days to equilibrate (Oluwole *et al*., 2012). About 5 kg of pods was taken from each variety and were manually shelled to obtain intact seeds. The seeds were stored in separate sealed polyethylene bags to maintain the moisture level of the samples.

Moisture Content Determination

Prior to oil extraction, the moisture contents of the seeds were determined using the method reported by ASAE (1983), Aviara *et al.* (2005), Oluwole *et al.* (2007a & b). This method involves oven drying of samples at 130^{O}C for 6 hours.

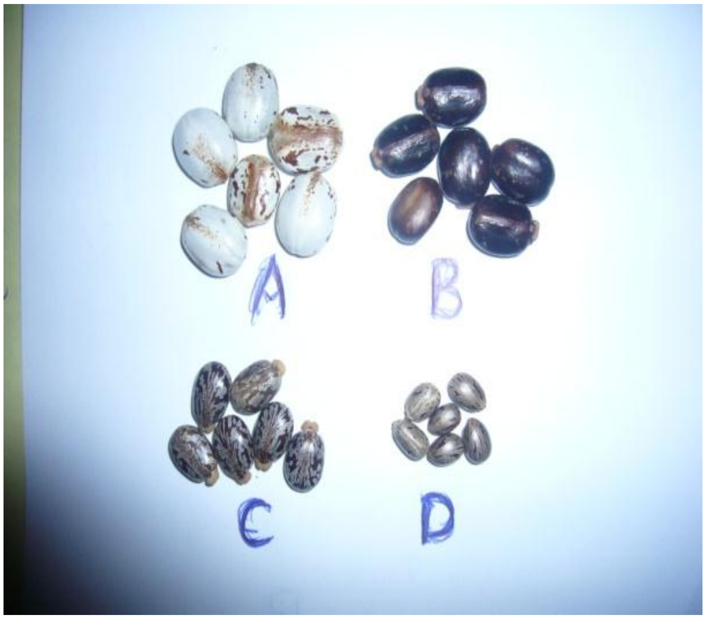

Figure 1.Common Castor seeds: A -WBS; B -BBS; C -GMS; D –GSS

((WBS)-White Big Size, (BBS)-Black Big Size, (GMS)- Grey Medium Size and (GSS)-Grey Small Size)

Castor Seed Oil Content Determination

The seeds were prepared by decorticating (removing the endocarp) and winnowing to separate the shell from the cotyledon. About 250 g of each seed sample was milled to reduce the particle size. 200 ml of methanol was poured into round bottom flask. Twenty grams of milled seed sample was placed in the thimble and was inserted in the centre of the extractor. The soxhlet was heated at 60 ^{O}C. When the solvent was boiling, the vapour rose through the vertical tube into the condenser at the top. The liquid condensate dripped into the filter paper thimble in the centre, which contained the milled seed sample to be extracted. The extract seeped through the pores of the thimble and filled the siphon tube, where it flowed back down into the round bottom flask. This was allowed to continue for 3hrs 30min. The thimble was then removed from the tube, dried in the oven, cooled in desiccators and weighed to determine the reduction in weight. The experiment was replicated three times for all the four varieties of castor. At the end of the extraction, the resulting mixture containing oil and methanol was heated to remove methanol (solvent) from the oil.

The seed oil content was determined following the method reported by Olaniyan (2010) as:

$$Q_o = \frac{M_O}{M_S} \times 100\% \qquad 1$$

where

Q_O = oil content, %
M_O = mass of oil extracted, g
M_S = mass of milled seed, g

Characterization of Castor Oil

The oils extracted from the four castor seeds varieties were investigated for some physio-chemical properties following the methods reported by Akpan *et al.* (2006), Olutoye and Garba (2008) and Shridhar *et al.* (2010). The properties included acid value, saponification value, iodine value, refractive index, viscosity, specific gravity, peroxide value and pH value.

Determination of Moisture Content

The seed moisture content was determined using the method described by Ajibola *et al* (1990) for rubber seed Aviara *et al* (1999) for guna seeds, Tunde-Akintunde *et al* (2001) for soy bean and Aviara *et al* (2005) for sheanut. This method involved the oven drying of oil seed samples at 130^0C for 6 hours, with weight loss monitored on hourly basis to give an idea of the time at wish; the weight began to remain constant. The seeds were weighed after oven drying to determine the final weight. Moisture content was determined using the formula: -

$$M_{wb} = \frac{M_i - M_f}{M_f} \times 100 \qquad 2$$

It was converted to the dry basis moisture content using the formula

$$M_{db} = \frac{M_i - M_f}{1 - Mwb} \times 100 \qquad 3$$

where Mwb = Wet basis moisture content, %
Mi = initial weight of sample, g
Mf = final weight of dry sample, g
where M_{db} = dry basis moisture content, %

Determination of acid value (AV)

Method described by ASTM (2002) was used. Twenty-five ml of diethylether was mixed with 25ml of ethanol in a flask. 2g of each oil sample was dissolved in the prepared solution. 1ml of 1% phenolphthalein was added and then heated in a water bath for 15min. The hot mixture was titrated with 0.1ml sodium hydroxide (NaOH) as base, using phenolphthalein end point (pink) as an indicator. The end point was noted when the addition of a single drop produced a slight colour change persisting for at least 15sec this was replicated three times. The acid value was determined using the following formula:

$$\text{Acid Value (AV)} = \frac{\text{Titration (ml)}\times 5.61}{\text{weight of sample used}} \qquad 4$$

Determination of Iodine Value (IV)

Wij's method was applied to determine the iodine value (IV) as reported by Mesfin (2008). About 2g of oil sample was dissolved in 10 ml carbon tetrachloride in a 250 ml conical flask. 20 ml of 0.2N Wij's solution (prepared by dissolving 9 g of iodine trichloride in a mixture of 700 ml glacial acetic acid (purity at least 99%) and 300 ml carbon tetrachloride) was added from a burette. The flask was closed, mixed and allowed to stand in the dark at about 20 - 30℃ for 30min. After standing for 30 min, 15 ml potassium iodide solution and 100 ml water were added. The iodine liberated by the process was titrated with sodium thiosulphate solution while shaking and starch indicator was added towards the end of titration (and volume V_a was recorded). Blank determination was made with the same quantities of reagent at the same time and under the same conditions (and the volume V_b as recorded). Finally the iodine value (IV) was determined using the following formula:

$$\text{Iodine value (IV)} = \frac{(V_b - V_a)1.269}{\text{wt of sample(g)}} \qquad 5$$

where, V_a = volume of thiosulphate solution used in the test, ml
V_b = volume of thiosulphate solution used in blank, ml

Determination of Saponification Values

Method described by Shridhar *et al.*,(2010) was used to determine the saponification value. Two grams of the oil samples was weighed into 250 ml conical flask with accuracy of 1mg. 50ml of 0.5N ethanolic potassium hydroxide solution was added to the cold oil and the reflux condenser attached to the flask. The mixture was heated, and as soon as the ethanol boils, the flask was shaken occasionally until the oil was completely dissolved, 1ml of phenolphthalein indicator was added and the hot soap solution obtained was slowly titrated with 0.5N hydrochloric acid (and volume V_a was recorded). And a blank determination was carried out upon the quantity of potassium hydroxide solution at the same time and under the same conditions (and volume V_b was recorded). The saponification value was calculated as follows:

$$\text{Saponification value (SV)} = \frac{(V_b - V_a)28.05}{\text{wt of sample}} \text{ (Mg KOH/g)} \qquad 6$$

where, V_a = volume of hydrochloric acid used in the test, ml
V_b = volume of hydrochloric acid used in blank, ml

Determination of Peroxide Value

The method described by Mesfin (2008) was used to determine the peroxide value. Five grams of oil sample was weighed with accuracy to 5mg into a 250ml conical flask. 30ml of the solvent (2 volumes of glacial acetic acid and 1 volume of chloroform) was added and air above the liquid was displaced with carbon dioxide. Then 1ml of the potassium iodide solution was added and a homogenous solution resulted. The solution was allowed to stand in the dark for 1 min, and 30ml water was added. This solution was then titrated with 0.1M sodium thiosulphate solution, using a few ml of starch as indication (the volume V_a recorded). A blank determination was simultaneously run and (the volume V_b recorded). This was repeated three times. The peroxide value was calculated as follows:

$$\text{Peroxide value (PV)} = \frac{1000 \text{ x } 0.1\ (\text{Va} - \text{Vb})}{\text{Wt of oil sample}} \qquad 7$$

where, V_a = volume of sodium thiosulphate solution used in the test, ml
V_b = volume of sodium thiosulphate solution used in blank, ml

Determination of Refractive Index

The refractive was determined using method described by Akpan *et al.* (2006), Olutoye and Garba (2008) and Shridhar *et al.* (2010): Refractometer (model: RFM 340. Bellingham & Stanley ltd) was used in this determination for each of the castor oil samples, few drops of the oil samples were transferred into the glass slide of the refractometer. Water at 30^o C was circulated round the glass slide to keep its temperature uniform. Through the eyepiece of the refractometer, the dark portion viewed was adjusted to be in line with the intersection of the cross. At no parallax error, the pointer on the scale printed to the refractive index. This was repeated three times and the mean value noted and recorded as the refractive index.

Determination of relative density (Specific gravity)

The relative density was determined using method described by Akpan *et al.* (2006), Olutoye and Garba (2008) and Shridhar *et al.* (2010): A clean and dry density bottle of 25ml capacity was weighed (W_0) and then filled with the oil sample, stopper inserted and weighed to give (W_1). The oil was substituted with water after washing and drying the density bottle and weighed to give (W_2). The expression for specific gravity is:

$$\text{Sp. gr.} = \frac{(W_1 - W_0)}{(W_2 - W_0)} = \frac{mass\ of\ substance}{mass\ of\ equal\ vol.of\ water} \qquad 8$$

where W_o = mass of density bottle, g
W_1 = mass of density bottle and substance, g
W_2 = mass of density bottle and water, g

Determination of viscosity

The viscosity was determined using method described by Akpan *et al.* (2006), Olutoye and Garba (2008) and Shridhar *et al.* (2010): A clean, dried viscometer with a flow time about 200 seconds for the fluid to be tested was selected. The sample was filtered through a sintered glass (fine mesh screen) to eliminate dust and other solid matters in the liquid sample. The viscometer was charged with the oil sample by inverting the tubes thinner arm into the liquid sample and suction force was drawn up to the upper timing mark of the viscometer, after which the instrument was turned to its normal vertical position. The viscometer was placed into a holder and inserted to a constant temperature bath set at 29^{o}C and allowed for approximately 10 min for the sample to come to the bath temperature at 29^{o}C. The suction force was then applied to the thinner arm to draw the sample slightly above the upper timing mark to the lower timing mark was recorded.

Determination of pH value

Two grams of the oil sample was poured into a clean dry 25ml beaker and 13ml of hot distilled water was added to the sample in the beaker and stirred slowly. It was then cooled in a cold – water bath to 25^{o}C. The pH electrode was standardized with buffer solution and the electrode immersed into the sample and the pH value was read and recorded.

The obtained seeds oil content and oil properties were subjected to analysis of variance (ANOVA) using full factorial design in the Design-Expert statistical package (Stat-Ease Inc. 7.0 USA), and model equations were generated.

RESULTS AND DISCUSSION

Table 1 shows the summary results of the oil content and seeds moisture content of the four castor seeds varieties. It is observed from this table that the GMS gave the highest oil content of 54.5%, followed by the GSS which gave 40.17%, then the WBS which gave 35.5% and the least oil content was observed from the BBS which gave 29.67%. This may probably be the reason why researchers get different oil contents since they did not specify the varieties of castor seeds used.

Table 1: Summary of Oil Content of Castor Seeds

Seed Variety	Moisture Content %(db)	Oil Content wt/wt(%)
WBS	6.05	35.50 ^{c}
BBS	7.19	29.67 ^{d}
GMS	7.68	54.50 ^{a}
GSS	5.75	41.17 ^{b}

WBS-white big size; BBS-black big size; GMS-grey medium size; GSS-grey small size

In order to verify the conclusion drawn from Table 1 on the seed oil content, analysis of variance (ANOVA) was employed. The analysis of variance (ANOVA) in Table 2 revealed that the observed differences in oil content of the four castor seed varieties were significant at 5% level.

Table 2: ANOVA Table for Seed Oil Content

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Model	1011.90	3	337.30	622.71	< 0.0001	significant
A-seed Variety	*1011.90*	*3*	*337.30*	*622.71*	*< 0.0001*	
Pure Error	4.33	8	0.54			
Cor Total	1016.23	11				

$R^2 = 0.9957$

The model equation developed for the seed oil content in terms of coded value is given in equation 9.

$$\text{Oil content } (\mathbf{O}_C) = 39.96 - 4.46A_1 - 10.29A_2 + 14.54A_3 \qquad 9$$

where A stand for the coded value of seed variety
(for WBS, values of $\{A_1, A_2, A_3\} = \{1, 0, 0\}$; for BBS = $\{0, 1, 0\}$; for GMS =$\{0, 0, 1\}$ and for GSS =$\{-1, -1, -1\}$

The positive coefficient term in equation 9 obtained from Table 3 indicated that the GMS had positive influence, while the negative terms indicated that the WBS and BBS had negative influence on the oil content.

In order to validate the model developed, the coded terms $\{A_1, A_2, A_3\}$ in equation 9 were substituted with their corresponding values as described above. The model predicted that oil contents of GMS, GSS, WBS and BBS were 54.50, 40.17, 35.50 and 29.67 respectively. Table 4 presents the result of the experiments and predicted values of oil content of the castor seeds. It is evident from Table 4 that the experimental (actual) values are closed when compared with the predicted values of the oil content.

Table 3: Regression coefficient of the oil content

Term	Coefficient Estimate	df	Standard Error	95% Cl Low	95% Cl High
Intercept	39.96	1	0.21	39.47	40.45
A_1	-4.46	1	0.37	-5.31	-3.61
A_2	-10.29	1	0.37	-11.14	-9.44
A_3	14.54	1	0.37	13.69	15.39

$R^2 = 0.9957$

Table 4: Results of Oil Content of Castor Seeds

S/No.	Seed Variety		OIL CONTENT (%)	
	Actual	Coded		
		{A_1 A_2 A_3}	Actual	Predicted
1	WBS	{ 1 0 0 }	34.50	35.50
2	WBS	{ 1 0 0 }	36.00	35.50
3	WBS	{ 1 0 0 }	36.00	35.50
4	BBS	{ 0 1 0 }	29.00	29.67
5	BBS	{ 0 1 0 }	29.50	29.67
6	BBS	{ 0 1 0 }	30.50	29.67
7	GMS	{ 0 0 1 }	55.00	54.50
8	GMS	{ 0 0 1 }	54.50	54.50
9	GMS	{ 0 0 1 }	54.00	54.50
10	GSS	{ -1 -1 -1 }	39.50	40.17
11	GSS	{ -1 -1 -1 }	40.00	40.17
12	GSS	{ -1 -1 -1 }	41.00	40.17

WBS-White Big Size; BBB-Black Big Size; GMS-Grey Medium Size; GSS-Grey Small Size

Table 5 shows the results of oil properties obtained from dehulled and undehulled castor seeds. It is observed from this table that acid value, saponification value and pH value of extracted oil from castor seed varieties indicated significant difference at 5 % level. Generally, oil from undehulled seeds had higher acid value than the dehulled seeds. This may probably be due to the fact that the castor seeds chaff may contain acid.

Table 5: Results of the oil properties of castor seeds from dehulled and undehulled seeds

	Factors		**Response**							
S/No.	**Seed Variety**	**Seed Condition**	**Acid Value**	**Saponification Value**	**Iodine Value**	**Specific Gravity**	**Viscosity**	**Refractive Index**	**pH Value**	**Peroxide Value**
1	WBS	Dehulled	2.00^{b}	183.43^{a}	82.33	0.965	1465	1.4773	4.01^{c}	8.6
2	BBS	Dehulled	1.40^{d}	180.11^{b}	84.76	0.956	1430	1.4771	4.01^{c}	9.6
3	GMS	Dehulled	1.01^{e}	165.32^{e}	85.78	0.965	1222	1.4772	4.04^{b}	4.3
4	GSS	Dehulled	1.40^{d}	178.69^{c}	85.23	0.905	1325	1.4774	4.02^{bc}	6.2
5	WBS	Undehulled	2.61^{a}	180.62^{b}	86.65	0.965	1509	1.4772	4.02^{bc}	9.7
6	BBS	Undehulled	1.52^{c}	181.43^{ab}	86.22	0.962	1155	1.4765	4.03^{b}	11.2
7	GMS	Undehulled	1.06^{e}	168.54^{d}	87.22	0.876	1232	1.4765	4.06^{a}	8.6
8	GSS	Undehulled	1.52^{c}	180.15^{b}	83.78	0.945	1360	1.4767	4.03^{b}	5.2

In each column, means with the same letters are not significantly different but means with different letters are significant at $P \leq 0.05$

Tables 6, 7 and 8 present the regression coefficients of the acid value, saponification value and pH value respectively, from where regression equations were generated (equations 10, 11 and12) to get the predicted values of the oil properties.

$$\text{Acid Value } (\mathbf{AV}) = 1.57 + 0.74\,A_1 - 0.11\,A_2 - 0.53\,A_3 + 0.11\,B \qquad 10$$

Table 6: Regression coefficient of the Acid value

Term	**Coefficient Estimate**	**df**	**Standard Error**	**95 Low % Cl**	**95%Cl High**	**VIF**
Intercept	1.57	1	0.065	1.36	1.77	
A[1]	0.74	1	0.11	0.38	1.10	
A[2]	-0.11	1	0.11	-0.46	0.25	
A[3]	-0.53	1	0.11	-0.89	-0.17	
B-seed Condition	0.11	1	0.065	-0.093	0.32	1.00

(Cl – Confidence Interval; VIF – Variance Inflation Factor)

Saponification Value (**SV**) = $177.29 + 4.74\ A_1 + 3.48\ A_2 - 10.36\ A_3 + 0.40\ B$ 11

Table 7: Regression coefficient of the Saponification value

Term	**Coefficient Estimate**	**df**	**Standard Error**	**95 Low % Cl**	**95%Cl High**	**VIF**
Intercept	177.29	1	0.64	175.25	179.32	
A[1]	4.74	1	1.11	1.22	8.26	
A[2]	3.48	1	1.11	-0.038	7.01	
A[3]	-10.36	1	1.11	-13.88	-6.83	
B-seed Condition	0.40	1	0.64	-1.63	2.43	1.00

(Cl – Confidence Interval; VIF – Variance Inflation Factor)

pH Value (pH) = $4.03 - 0.013\ A_1 - 7.500\text{E-}003\ A_2 + 0.023\ A_3 + 7.500\text{E-}003 B$

Table 8: Regression coefficient of the pH Value

Term	**Coefficient Estimate**	**df**	**Standard Error**	**95 Low % Cl**	**95%Cl High**	**VIF**
Intercept	4.03	1	1.443E-003	4.02	4.03	
A[1]	-0.013	1	2.500E-003	-0.020	-4.544E-003	
A[2]	-7.500E-003	1	2.500E-003	-0.015	4.561E-004	
A[3]	0.023	1	2.500E-003	0.015	0.030	
B-seed Condition	7.500E-003	1	1.443E-003	2.907E-003	0.012	1.00

(Cl – Confidence Interval; VIF – Variance Inflation Factor)

where Seed variety = A; for WBS, $\{A_1\ A_2\ A_3\} = \{1\ 0\ 0\}$
For BBS, $\{A_1\ A_2\ A_3\} = \{0\ 1\ 0\}$;
For GMS, $\{A_1\ A_2\ A_3\} = \{0\ 01\}$
and GSS, $\{A_1\ A_2\ A_3\} = \{-1\ -1\ -1\}$
nature of seed = B; for dehulled seed, $\{B\} = \{-1\}$; and for undehulled seed, $\{B\} = \{1\}$.

The model equation developed for the oil properties in terms of coded value are presented in equations 10, 11 and 12. In order to validate the model developed, the coded terms {A_1, A_2, A_3} for seed variety and {B} for nature of seed in these equations were substituted with their corresponding values as described above.

Table 9 shows the actual and predicted values of the oil properties. It is observed from Table 9 that the experimental (actual) values are closed when compared with the predicted values of the oil properties.

Table 9: Actual and predicted properties of castor oil

Response	WBS				BBS			
	Dehulled		Unehulled		Dehulled		Unehulled	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
Acid Value	2.0	2.19	2.61	2.42	1.4	1.35	1.52	1.57
Saponification Value	183.43	181.63	180.62	182.42	180.11	180.37	181.43	181.17
Iodine Value	82.33	83.77	86.65	85.21	84.76	84.77	86.22	86.21
Specific Gravity	0.965	0.970	0.965	0.960	0.956	0.964	0.962	0.954
Viscosity	1465	1510.25	1509	1463.75	1430	1315.75	1155	1269.25
Refractive Index	1.477	1.478	1.477	1.477	1.477	1.477	1.477	1.477
pH Value	4.01	4.01	4.02	4.02	4.01	4.01	4.03	4.03
Peroxide Value	8.6	8.4	9.7	9.9	9.6	9.65	11.2	11.15
Response	WBS				BBS			
	Dehulled		Unehulled		Dehulled		Unehulled	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
Acid Value	1.01	0.92	1.06	1.15	1.4	1.35	1.52	1.57
Saponification Value	165.32	166.53	168.54	167.33	178.69	179.02	180.15	179.82
Iodine Value	85.78	85.78	87.22	87.22	85.23	83.78	83.78	85.23
Specific Gravity	0.965	0.926	0.876	0.915	0.905	0.930	0.945	0.920
Viscosity	1222	1250.25	1232	1203.75	1325	1365.75	1360	1319.25
Refractive Index	1.477	1.477	1.477	1.477	1.477	1.477	1.477	1.477
pH Value	4.04	4.04	4.06	4.06	4.02	4.02	4.03	4.03
Peroxide Value	4.3	5.7	8.6	7.2	6.2	4.95	5.2	6.45

CONCLUSION

In this study, oil was extracted from four varieties of castor seeds using soxhlet extractor, in order to determine the oil content of the seeds and investigate the physico-chemical properties of the oil. The conclusion derived from this study shows that the GMS had the highest oil content of 54.5%, followed by the GSS (41.17%), then the WBS (35.5%) and the least of 29.67% is from the BBS. The acid value, saponification value and pH value significantly differs while iodine value, specific gravity, viscosity, refractive index and peroxide value show no significant difference at 5% level. This information would be of help to castor oil processors in selecting the appropriate castor seed for commercial purpose.

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